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Using Delphi to Track Shifts in Meanings of Scientific Concepts in a Long-term, Expert-lay Collaboration on Sustainable Agriculture Research in the Midwest

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ABSTRACT: Dilemmas for ongoing expert-lay collaborations for agricultural conservation include divergence of meaning of new scientific concepts. Delphi method documented stakeholders' understandings of a new term, "ecosystem services." Flood mitigation and pest management benefits as ecosystem service attributes were ranked lower by stakeholders than anticipated by scientists. Recreation and aesthetics, and food production, were ranked higher.

KEYWORDS: conservation, ecosystem services, erosion, land-grant university, National Wildlife Refuge, participatory, prairie, water quality

1. INTRODUCTION

Participation of citizens and stakeholders in the development of agricultural technologies and in land management is common turf for expert-lay collaborations, as well as expert-lay conflict. When successful and authentic, participation contributes to greater democratization of science and technology (Peters, Jordan, Adamek, & Altern, 2005; Sclove, 1995; Williamson & Smoak, 2005). Academics and practitioners have studied mainly the start-up phase of collaborations. Scott Peters and associates (2005) dwell on the legacy of participation of citizens with land-grant researchers and its extension and outreach functions – key responsibilities for many of the researchers discussed herein. The authors bemoan the demise of vigorous cooperative ventures that provide a foil for transfer-of-technology approaches, and other processes in which experts dominate. MacKenzie (1996) details a multi-year, multi-institutional process for improving water quality of the Great Lakes. She lauds the production of new scientific knowledge, but speaks to its limited influence on outcomes: "Despite additional scientific knowledge about the nature of water resources and their interactions within the ecosystem, incremental and fragmented management has limited the capacity of institutions to respond meaningfully" (MacKenzie, 1996, p. 5). Academics and professionals

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studying the phenomenon of multi-stakeholder collaborations worry, like MacKenzie, about the difficulties associated with convening disparate groups, and keeping science in the mix.

After convening, a next step would be for members of collaboration to "do something" together. If exemplary actions are taken, a collaboration may continue to involve both lay and experts in a process of contributing to, and creating knowledge for, solving intractable conservation and environmental problems (see also Carolan, 2006; de Groot, Alkemade, Braat, Hein, & Willemen, 2010; Hein, 2006; Röling & Wagemakers, 1996). The literature also relays cases of partial, disrupted, co-opted, or otherwise failed collaborations, with an undercurrent that suggests that participatory projects drain time and resources; and may pose risks to one's personal, professional, or institutional status. The literature on participation theory and practice has blossomed since the 1980s, and studies of "How To" are now common. The stance of the literature has described goals that have remained, for the most part, in service to democratic or other social change agendas (Sclove, 1995). Sclove delineates the types of gains from collaborations that contribute to democratization, yet recognizes uneven progress:

> Insofar as participatory design results in technologies or services that go on to help constitute the agenda for a democratic politics of technology, then RD&D can also embody that special dignity… However, RD&D processes can also be organized to be crimped and growth-impairing. (1995, p. 182)

2. NEW SCIENCE TERMS

This paper focuses on a different phase of collaboration, that of continuance and renewal of collaborations, dilemmas that typically appear in the middle of hard-won partnerships. It is our presumption that if the challenges are not solved using democratic processes similar to the ones that created them, collaborative ventures risk, (a) falling apart, (b) becoming co-opted by a dominant faction, and (c) doing nothing worthwhile.

In the study, empirical data were collected on a dilemma experienced by an already-established collaboration whose members have worked together long enough to (a) witness the emergence of significant findings ("hard results") from a project, and to (b) be introduced to new science terms used to describe their work. The "dilemma of the middle" challenges us to learn how established multi-stakeholder groups successfully maintain integrity while weathering turn-over in membership, fluctuating financial resources, and reconciliation of an individual's participation in the face of revolving-door strategic plans of home institutions. Our paper focuses on a change in scientific terminology associated with the fields of ecology and environmental economics. The term, "ecological services," was missing from most early (around 2002) conversations regarding the research, substantiated by verbatim field notes by Grudens-Schuck of early discussion of the stakeholder group and research team. By 2010, however, "ecosystem services" was employed in titles and project statements of most grant proposals, publications, and other deliverables (video, websites, press releases) associated with the project. The timing of arrival of the new term with respect to social development of the collaboration allowed theoretical investigations into dynamics of complex, multi-player, participatory environmental and agricultural research and development.

The Delphi study was conducted as part of research for a master's thesis of co-author Larsen. Grudens-Schuck is a university collaborator working with the research team, and also served as a member of Larsen's Graduate Committee. The "STRIPS at Neal Smith National

Wildlife Refuge" project within which this research report is nestled is much larger than the Delphi study; consequently, not wholly described herein (see Jarchow et al.., 2012; Home page http://www.nrem.iastate.edu/research/STRIPs/). STRIPS is an acronym for *Science-based Trials of Row Crops Integrated with Prairies*. "Neal Smith" names a central partner for the biophysical research: the *Neal Smith National Wildlife Refuge*, dedicated to prairie, including animals (such as American bison, elk, other native mammals, birds, and insects). An aspect that sets the larger project apart from more commonly conducted field-trial type research is (a) the project is a long-term ecological research project, and (b) the project is conducted on a large scale—that of three "whole" watersheds. In the main, the research team sought to test, and then introduce (where appropriate), "prairie strips" for use by farmers on row crop fields (corn and soybean) to lessen erosion and improve water quality. Funding was provided internally and externally, including by government agencies. Stakeholders spanned farm commodity groups, environmental nonprofits, and government staff. Day-long meetings, at least annually since 2003, also included walking the watershed-sized experimental "plots." Frequently, there was standing room only, with enthusiastic graduate students lining the room of the large educational conference room at the Neal Smith Wildlife Refuge, Prairie Learning Center (Home page: http://www.fws.gov/midwest/nealsmith/). A brief schematic follows which illustrates the experimental configuration.

Experimental Setup

The systems being studied include a range of percentage and placement of perennial vegetation ("prairie strips") in Figure 1. The project is being conducted (replicated) on fourteen small watersheds in and around the Neal Smith National Wildlife Refuge ranging in size from 1.2 acres to 13 acres.

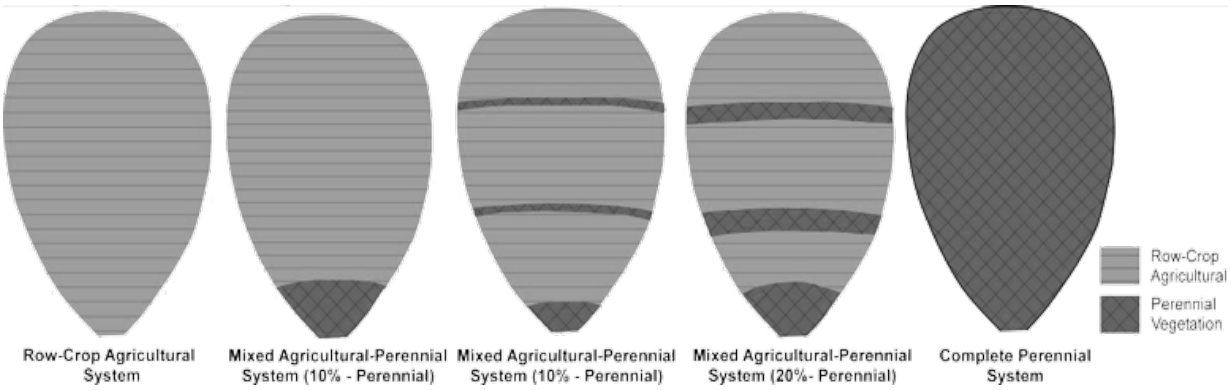

Fig. 1. Conceptual design of watersheds. Copyright 2012 STRIPS Research Team.

Stakeholders—up to 40 participating at a time in some meetings—have been involved at different stages of research planning, data collection, interpretation of annual data; and in discussions about securing external funding, and the impact funding would have on the core activities. What is referred to as the "research team" is the smaller group, composed of

scientists from university and government; program planners associated with biophysical, engineering, or social science; and those enrolled in a the land-grant MS or PhD degree.

2.1. Why "Prairie Strips"?

- Improved water cycling, including filtration that results in clean water.
- Nutrient cycling, which may reduce the amount of fertilizer needed
- Carbon cycling, which may address the need to retain carbon in other places than in the atmosphere, where it contributes to global climate change (global warming).
- Biodiversity, which seeks to retain species that contribute in ways that are known (fox eat rabbits; birds eat mosquitoes) and unknown.

These benefits to society may potentially be made easier, and more affordably delivered if the prairie strip idea works. So far, the data support the use of prairie and prairie strips in managing water at a level that is the same or better than established conservation measures (see also Atwell, Schulte, & Westphal, 2010; Jarchow & Liebman, 2010; Larsen, 2011; URL: http://www.nrem.iastate.edu/research/STRIPs/research/index.php). Findings have been breath-taking in their success thus far.

The research topic was considered key to the mission of several of the participating researchers and stakeholders. Surface and ground water contamination by agricultural run-off in the Midwest continues to make the news; especially in states such as Iowa—in the "breadbasket" of the U.S. For example, this state, a prime producer of corn, soybeans, and livestock, recently requested "more time" of the Environmental Protection Agency (EPA) to remediate its many "impaired waterways." Iowa, the site of the research, could not meet the first deadline, one of many such delays since creation of the Clean Water Act. Efforts to keep soil on the farm and out of ground and surface water predated the Act and creation of the EPA in this same area of the country. Intractable yet hard to ignore, land-grant colleges and universities, and newer government and non-profit agencies, have devoted decades of research and development to solving the "water quality problem." Despite a suite of affordable, and sometimes subsidized, technologies and management practices, farmland is not sufficiently protected from high-level erosion rates by riparian plantings, stream bank stabilization with rock or willow or crown vetch (*Coronilla sp*.), cover crops, reduced tillage practices, terracing, grassed waterways, or the "set aside" of highly erodible lands.

3. METHODS

The Delphi study focused more narrowly on ideas of stakeholders involved the project. This paper provides findings from a Delphi survey of twenty-one stakeholders, from the Master of Science thesis of Larsen (2011). Delphi is an individual, private, and multi-step survey process with an established history of success in predicting a "likely future" (Angus, Hodge, McNally, & Sutton, 2003). Delphi—as a method alone—is not presumed to be a participatory process itself. Typically, face-to-face dialogue, the more intense the better, is put forward as ideal in participatory and collaborative endeavors (Cuppen, 2012; Gutmann & Thompson, 1996; Oels, 2000; Röling & Wagemakers, 1998; Williamson & Smoak, 2005). However, there are differences of opinion regarding the warrant for employing one social science method over another, even within participatory endeavors. For the STRIPS stakeholder group, face-to-face

and phone contact were frequent. Individuals crossed paths professionally in associations such as the Iowa Prairie Network, and in farm conferences and equipment shows. What was novel was the opportunity that Delphi afforded: a chance to complete a questionnaire that (a) was close to their hearts, (b) asked about a topic stakeholders knew a lot about, and (c) was conducted absent the din of normal meeting-room chatter that does not always permit reflective thinking. Delphi seemed to fit also because the question was direct, and because there was not prior consensus about the term "ecosystem services." It was known among the team and stakeholders that the terms were not yet an easy fit. Classic Delphi technique requires a purposefully selected group of experts. This study fulfilled this criterion. In this study, a census sample was conducted; in other words, all stakeholders were provided opportunities to contribute to the confidential, 3-round Delphi process. Delphi's power comes from its ability to predict the most likely future, mainly because the people surveyed are intimately involved in the issue, and are able to express both conscious and unconscious preferences and restrictions.

3.1 Where did "ecosystem services" come from?

The strong wave that thrust the research team into the semantic arena of "ecosystem services" as well as "multifunctional agriculture," according to retained ethnographic field notes and team meetings, field days, and stakeholder meetings [by Grudens-Schuck and others], was the demand from external funders—mainly federal. It would be too much to list the funding sources large and small, and all important, in this paper. However, one must speak plainly: the emphasis on conjoining ecosystem services with the project goals and rhetoric was funder-driven. Funders, as far as we can tell, adopted the term from the ecological sciences and environmental economics. In a 2010 editorial, Rudolf de Groot, editor of a fairly new peer-review journal called *The International Journal of Biodiversity Science and Management,* declared the new title, *The International Journal of Biodiversity Science, **Ecosystem Services**, and Management* [authors' emphasis]. De Groot explained that the term migrated from science to policy making, and emphasized the human element—a potential recipient of benefits from ecological management. Heretofore, biodiversity and ecology were broadly viewed to benefit wildlife and habitat, sometimes holding out the possibility that scientific and medical advances could be identified by a yet-unknown species. Most descriptions in the publications of the team, and in talks given to each other and stakeholders, emphasize the benefits of landscapes to provide much more than food. In this way, the "ecosystems services" phrase made visible the formerly externalized gains (i.e., ecological services) from landscapes; benefits that were not sufficiently realized or valued. In sum, ecosystem services were talked about by scientists and other experts as distinct from production capabilities of landscapes. Conceptually, ecosystem services were additive, not integral to, farm and ranching.

4. FINDINGS

The Delphi study produced both confirming and disconfirming ideas. A few will be highlighted to illustrate how research functioned within a multi-stakeholder group. Next, it will be necessary to explain the gaps or differences in understanding of scientific terms in terms of the dialectic of agreement and disagreement embedded in the concept of democracy (Bills & Gross, 2005; Cuppen, 2012; Gutmann & Thompson, 1996).

(A) Flood mitigation and pest management were ranked lower by stakeholders than by most members of the research team.
(B) Recreation and aesthetics were ranked higher by stakeholders as key objectives than by members of the research team.
(C) Production of food was ranked highly as a feature of ecosystem services—even though scientists' talk indicated that ecosystem services consisted of benefits above and beyond commodity food production (corn and soy).

All three findings stand out for reasons related to the history of the group, its funding, and the changing interests of the institutions that support stakeholders' role in the group.

4.1 Flooding and Water Quantity

The surprise regarding the lower ranking for flood mitigation potential of the STRIPS project was palpable. In four years (2008-2012), large portions of the state of Iowa received flash floods, devastating rising waters over levies of rivers near key cities in Iowa. Distressingly, each event was "not supposed to happen" statistically or historically. Neither team members nor stakeholders were spared from effects of the floods. Moreover, team members had for many years been involved in shared goals for reducing soil eroded from Iowa farm fields contaminating the major rivers into which the watersheds (i.e., Mississippi, Missouri) delivered their mix of sediment, as well as trash, and chemicals and biological contaminants, mixed with more of the same from other sectors.

4.2 Recreation and Aesthetics

When working on big projects with big goals, congruence with larger missions of the major institutions is usually present. Moreover, it is a grapevine phenomenon that farmers and their experts risk being taken less seriously if recreation and open-space views are a major thrust of an agro-ecological project. Consequently, it came as a surprise that these elements were ranked so highly.

4.3 Food Production

Food production was, most of the time, talked about by scientists as a given. What were needed sorely were the ecosystem services that would help to clear impaired waters; reduce soil erosion; and slow the movement of water, which routinely de-stabilized river banks and collapsed bridges and dams, overwhelming the ability of local governments to manage infrastructure repairs.

4.4 Other Findings

Stakeholders' initial list of ecosystems services terms contained sixty items describing an array of services and processes across a wide range of scales from field to global. Similar to flooding, wildlife and biodiversity were surprisingly ranked lower than expected in light of emphasis given in research talks and publications.

5. DISCUSSION

The three findings of discrepancies (broadly speaking) between research team members and stakeholders would provide sufficient fodder for long meetings and fervent emails. With respect to development of the wherewithal of stakeholders and citizens to participate wisely in democratic decision making about complex landscape topics, is it good or bad that the survey arrived at these findings? Moreover, would it be wise or foolish to place the discord squarely in front of both stakeholders and team members—perhaps while in the same room? Answers to these questions can move in opposite directions. In a command-and-control social environment, "negative data" are seen as an element to be hidden or glossed over. In a democratic environment, authentic differences are valued for their potential for learning laterally; and for allowing for stakeholders to make recommendations for change to the project in line with their understandings and rankings (Röling & Wagemakers, 1998; Ruhl, Kraft, & Lant, 2007). This claim falls in line with Gutmann and Thompson's (1996) distinctions between procedural democracy, which is more rule-based; constitutional democracy, which demands a just outcome; and deliberative democracy, which emphasizes ongoing discussion, with attention to power issues within the group. They write:

> Deliberative democracy rejects [this] dichotomy. It sees deliberation as an outcome-oriented process; citizens deliberate with the aim of justifying their collective decisions to one another as best they can. (Gutmann & Thompson, 1996, p. 27)

These discussions have begun, and will take months to impact decision making. A deliberative democratic thrust would suggest allowing—even facilitating—exploration and disagreement regarding the term "ecosystem services." It is anticipated that the road of deliberative democracy will allow members of the research team (old and new) and the stakeholder group (old and new) to vigorously support the research while remaining ambivalent or in disagreement about the scope or extent of adoption of prairie strips. There are other benefits to a deliberative approach. Taking care of smaller disagreements renews trust and builds understanding at a human pace. On the other hand, learning at a later time about data that were "hidden" undermines collaborations (Hein, 2007). Moreover, there is always the wonderful event when collaborators learn that stakeholders are correct and scientists wrong. In fact, one of the findings fits this last phenomenon. It is understandable, given the degree to which prairie has been destroyed for crop and livestock production, that scientists emphasize the "other than" quality of ecosystem benefits with respect to returning prairie to the state with the largest historical swatch of Tall Grass prairie. However, it is incorrect per the emerging definition of the "ecosystem services" term. For example, de Groot (2010), in his editorial justifying the addition of "ecosystem services" to the journal discussed earlier, provides a list of elements of ecosystem services—and it includes the production of food.

6. CONCLUSION AND REFLECTION

It is inaccurate to state that the goal of the Delphi study was to stimulate argumentation, reflective thinking, and the exercise of deliberative democracy. The goal was to clarify, in a short period of time, a term that has become central to the narratives of the research team. Moreover, stakeholders and team now have sufficient data to move into an "adoption" phase. This phase would demonstrate and explain prairie strips, and the research behind them, to

farmers and land owners. The overall goal—integral to a land-grant mission—is to facilitate good decision making. The hope is to ready Iowa and its watersheds to provide more functions than it has in the last 150 years (e.g., food and fiber). Members of the research team badly want a lot of farmers to use the prairie strip technology; but it cannot be a "sales job" as long as the wherewithal of farmers to make some decisions about their land is respected. A practical question for the collaboration might be: should the term "ecosystem services" be featured in "technology transfer"? By how many, or to what extent, do the members of the collaboration need to be in agreement for the term to be featured? These questions are useful; but in the end, Gutmann and Thompson (1996) would suggest that disagreement and the need "to discuss" will not go away, and should not go away.

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